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ROLE OF ELASTOGRAPHY IN CHARACTERIZING BREAST MASS WITH HISTOPATHOLOGICAL CORRELATION.

Radiology

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ABSTRACT

AIMS & OBJECTIVE: To evaluate the role of elastography in characterization of a breast mass as benign or malignant with histopathological correlation.

METHODS: The study undertaken over 50 women with 60 breast lesions were enrolled randomly and assessed with sonography and elastography. All the lesions were confirmed by pathological result with the specimens from surgery or USG guided core biopsy or fine needle aspiration cytology.

RESULT: The study shows out of 60 lesions, 30 lesions were benign (26 were fibroadenoma) and 30 lesions were malignant (16 were invasive ducal carcinoma). Out of 30 benign lesions elastography correctly characterized 28 lesion as benign with strain ration value less than 2. Out of 30 malignant lesions elastography correctly characterized 28 lesions as Malignant with strain ration value more than 2.

CONCLUSION: Elastography is highly effective in predicting nature of lesion so may reduce need for unnecessary biopsy in suspicious lesions and post-pone follow-up. Elastography has proven to effective in managing nodule <5 mm in size which are not visible on mammography or difficult to characterized on USG.

KEYWORDS

USG, Elastography, Benign, Maliganant, Strain Ratio

INTRODUCTION:

Breast cancer is one of the foremost common cancers in women and its leading cause of cancer mortality in women and constitutes 14% of female cancer passing(1). The expanding worldwide rate of malignant maladies has been recorded by World Health Organization (WHO) and is an issue of genuine concern, especially in creating countries where the increment appears to be more dominant. Breast is reliable of diverse tissues counting fibrous, glandular as well as fatty tissues. The soft consistency of the breast is made of fatty tissues that encompass the breast glands.

Distinctive breast lesions are shown, fibroadenoma is considered the commonest benign tumor whereas the invasive ductal carcinoma is the commonest malignant tumor. Therefore, elastography has as of late been presented to move forward the exactness and specificity of diagnostic ultrasound. Ultrasound elastography is utilized to evaluate tissue stiffness(8). The procedure depends on the hypothesis that malignant and benign breast lesions have inalienable contrasts in solidness. Distinctive ultrasound elastography procedures have been risen, counting compression strain imaging, and real-time shear velocity. These days compression ultrasound elastography is considered the foremost commonly utilized strategy in breast imaging. A color outline is produced and is comparing to the gray-scale ultrasound images. A grading scale utilized to classify lesions, concurring to the color signature, has been presented by Youk et al. [9] (Table 1). The point of this pondering was to assess the diagnostic utility of sonoelastography in combination with ultrasonography in arranging to distinguish breast masses (benign from malignant).

Table:- 1

Pattern Criteria of Colure Distribution	Result
Homogenously light or dark blue	Benign
Heterogeneously, predominantly blue with spot-like green or orange	Benign
Heterogeneously, with patchy green, yellow or red	Malignant
Extremely heterogeneously, multicolor with red, orange, green, blue and irregular areas without colors, which can be named `multicolor sign	Malignant

MATERIALS AND METHODS:

Inclusion criteria

- All female patients clinically diagnosed with a palpable breast mass.
- Patients with masses discovered incidentally on routine screening.

Exclusion criteria

- Patients who are already diagnosed and treated for breast lump.
- Patients with post-traumatic/ post-infective breast swelling.
- Patients with physiological breast swelling.
- Patients not giving written informed consent.

Study period

- January 2019- October 2019 (10 months).

Study population

- 50 women from 22 to 61 year age

Methodology:

- A standard conventional US examination, including B-mode US and color Doppler US examinations, were performed in all the patients. Firstly, the patients were asked to take the supine position with both breasts fully exposed. The transducer was gently placed on the breast with light pressure. The patients were asked to hold breath. Meanwhile, the conventional USG scanning was performed and the USG features of the lesion were evaluated. Conventional USG assessment was completed after the routine clinical examination by the consultant physician.
- The method used for elastography was real-time strain elastography which generates "strain imaging" by compression.
- RTE was performed using Samsung Medison RS80A US scanner and a LA4-18B linear array transducer (transducer frequency range of 4-18 MHz) with dedicated software. This method assesses the relative elasticity of the tissues in a specific area of interest (the RTE-box).
- The US image was adjusted to ensure the lesion was placed in the center of the screen. Then RTE was initiated in the longitudinal section of the breast lesion with the probe at an angle of 90 degree to the skin surface and a sufficient amount of ultrasound jelly between the ultrasound probe and the skin.
- A minimal manual pressure was generated on the lesion with light up and down movement of the probe perpendicular to the skin surface. Breast elastography creating an elastogram that is superimposed to the USG image. Real-time display was used for quick assessment of the strain distribution.
- When sufficient elastogram was obtained as indicated by the standardized in- built machine criteria the section was freezed on the screen. A small ROI box was used to mark the region of interest

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with the box including the lesion only.

- The machine automatically measured the strain of surrounding tissue and provided a strain ratio for the lesion under study. The ROIs were placed on different locations in the lesion, including the high stiffness area and low stiffness area as depicted by the color map.
- In general, 2-3 measurements were performed and the average value was recorded. All data were recorded and stored to internal memory of the US machine for further analysis. Both US examinations and strain elastography measurement were performed by the same operator.
- The elastogram, was displayed on the screen which reflects the relative elasticity of the tissues, as a color coded map (the areas of great stiffness are coded in blue, those which are more deformable in red, and green indicates intermediate levels of elasticity).

Assessment standards

- Strain Ratio, Size of the lesion

Statistical analysis

- All data was analyzed using the Microsoft Excel software. Statistical analysis of data was done after compiling and tabulation of data.

RESULTS:

- Fifty women with 60 breast lesions were assessed in the study. Pathological results showed that 30 lesions were malignant and 30 lesions were benign. The 30 benign lesions included 26 of fibroadenoma, 1 of non-specific benign proliferation, 1 of abscess and 2 of papilloma; and the 30 malignant lesions included 16 of invasive ductal carcinoma, 2 of noninvasive ductal carcinoma, 1 of phyllodes tumor, 6 of lobular carcinoma, 1 of inflammatory carcinoma, 2 of papillary carcinoma, 1 of mucinous carcinoma and 1 of non-specific malignancy on cytology. The mean age was 44.5 years (range: 17-70 years) for patients with malignant lesions and 31.2 years (range: 16-46 years) for those with benign lesions. (Figure I)
- Out of 30 benign lesions elastography correctly characterized 28 lesion as benign with strain ration value less than 2. Out of 30 malignant lesions elastography correctly characterized 28 lesions as Malignant with strain ration value more than 2. (Figure II)
- 42 patients had only a single lesion. 5 patients had 2 lesions out of which 3 patients had unilateral benign lesions and 2 patients had bilateral malignant lesions. 1 patient had 3 lesions which were bilateral benign fibroadenomas. 1 patient had 4 bilateral benign fibroadenomas. The frequency of multiple lesions was more common in benign etiology. Bilateral Invasive lobular carcinoma was found in 2 patients. Multiple lesion in single breast was found in fibroadenomas followed by invasive ductal carcinoma. (Figure III)
- The mean size of malignant lesion was found to be higher than the mean size of benign lesions. Maximum malignant lesions were in the size range of >2 cm with largest being upto 7 cm. Benign lesions were smaller in size with maximum lesions in range of 3-3.9 cm. (Figure IV)

DISCUSSION:

Breast elastography has recently attained substantial attention as it has proven to reach a standard of specificity and a high negative predictive value. The usefulness of breast elastography has been confirmed in our study. Elastography may reduce the need for unnecessary biopsy in suspicious lesions and postpone follow-up(9). Elastography has a proved to have a significant role in guiding the management of nodules <5 mm which are not visible on mammography or difficult to characterize on USG, in which reduced deformability, as studied on elastography, may lead to biopsy rather than monitoring on follow-up as required by the current guidelines. Strain imaging elastography is a very useful tool in the assessment of elastic tissue properties of breast masses, due to its short examination time, real-time display, immediate results and limited cost(14). The criteria adopted in the characterization of breast lesions using strain values in this study have proven to be adequate in routine clinical practice.

However, the method does have certain limitations, as it is an semi-quantitative method which may be influenced by histological type and lesion size and it is an operator dependent technique which requires special training, experience and skills.

These limitations can be overcome by shear wave elastography, which is a quantitative method providing a more accurate assessment of tissue elasticity and stiffness. However, shear wave elastography also has its limitations such as the difficult in measuring in very stiff breast lesions. In this type of tumors, real- time elastography has demonstrated a high sensitivity which can compensate for the limitations of shear wave elastography. Considering that these two technical methods can complement each other, they should be combined to overcome the limitations of both.

- **Accuracy of elastography in identifying benign lesions**

Out of the 30 benign lesions, elastography correctly characterised 28 of the lesions as benign with strain ratio value less than 2. Thus, the positive predictive value for benign lesions on strain elastography in this study was 93.33%. This is in concurrence with previous studies conducted by Rizzatto et(19), Benign lesions were identified with a high specificity. Negative predictive value of 98% was obtained for the entire group of lesions and for lesions >5 mm in size, negative predictive value of 100% was obtained.

- **Accuracy of elastography in identifying malignant lesions**

In this study, strain elastography correctly identified 28 out of 30 lesions as malignant with strain ratio of more than 2.0, providing a positive predictive value of 93.3%.

This is in concurrence with the study conducted by Zhi et al.(16)The positive predictive value of elastography was same in identifying both malignant and benign lesions (93.3% each), indicating that strain elastography has high accuracy in characterising breast lesions as benign or malignant.

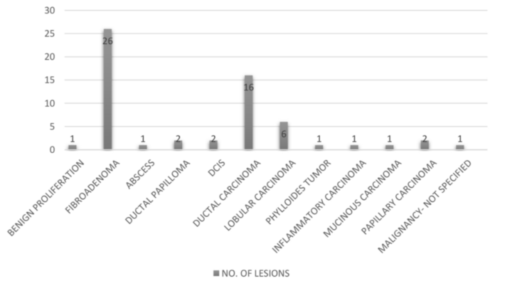

Figure: I

	STRAIN RATIO <2	STRAIN RATIO >2	TOTAL
BENIGN	28	2	30
MALIGNANT	2	28	30
	30	30	60

Figure: II

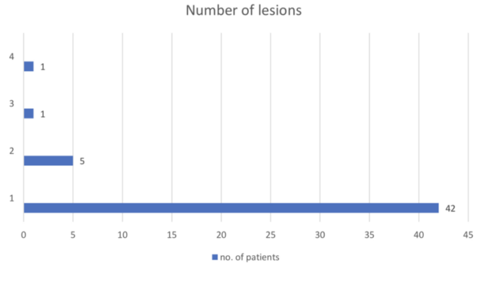

Figure: III

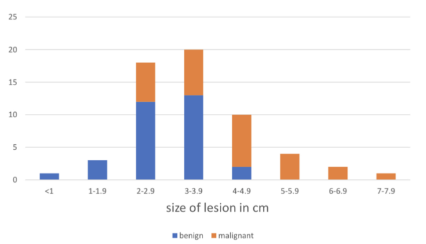

Figure IV

Image Legends:
Image 1: Invasive ductal carcinoma
Image 2: Lobular carcinoma
Image 3: Fibroadenomas
Image 4: Ductal papilloma
Image 5: Invasive lobular carcinoma

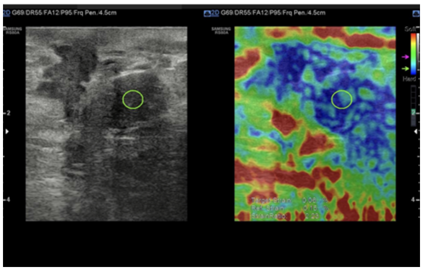

Image 1: Invasive ductal carcinoma

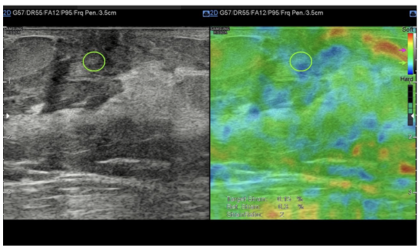

Image 2: Lobular carcinoma

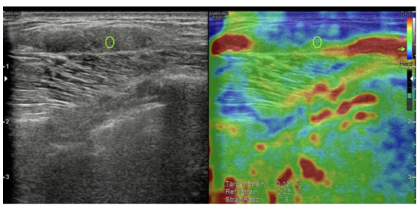

Image 3: Fibroadenomas

Image 4: Ductal papilloma

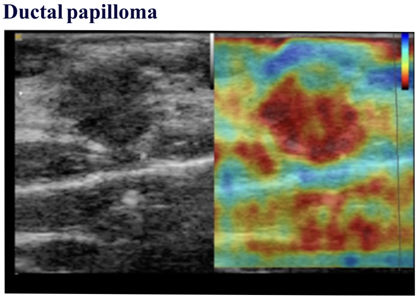

Image 5: Invasive lobular carcinoma

DECLARATIONS:

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